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AUTHOR(S):

YASUDA, TADASHI

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CITATION:

YASUDA, TADASHI. <Case Report>Displaced Physeal Fracture of the Olecranon in a Child : A Case Report. 日本外科宝函 1997, 66(2): 66-70

ISSUE DATE:

1997-05-01

URL:

<http://hdl.handle.net/2433/202866>

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## Displaced Physeal Fracture of the Olecranon in a Child: A Case Report

TADASHI YASUDA

Department of Orthopedic Surgery Moriyama City Hospital

Received for Publication, Feb. 25., 1997

A displaced, isolated fracture of the proximal physis of the olecranon is an unusual injury in children<sup>1-4)</sup>. Whereas a number of reports have described the methods and results of treatment for the fracture focusing on fracture healing, little attention has been paid to alterations in the fractured olecranon physis after treatment. In the current case of a displaced fracture of the proximal physis of the ulna, operative treatment with tension band wiring caused premature closure of the olecranon physis which resulted in no significant growth abnormalities at skeletal maturity. Timing of retained metal removal and operative methods to prevent premature closure of a displaced olecranon physis are discussed in the present paper.

### Case Report

A twelve-year-old boy fell and struck his right elbow directly on the ground during soccer game. He was seen in the hospital because of painful swelling in the elbow. Radiographs showed a displaced fracture of the proximal physis of right ulna (Fig. 1). Under general anesthesia and under fluoroscopic control, failure of the maintenance of an obtained reduction by manipulation necessitated open reduction and internal fixation. The fracture consisted of a Salter-Harris type II olecranon physeal injury with separation of the overlying periosteum and triceps expansion including organized intervening hematoma. After stabilization with two smooth Kirschner wires and a figure-of-eight loops of stainless-steel wires (Fig. 2-A), the fracture was immobilized in a plaster cast with the elbow in ninety degrees of flexion. Two weeks postoperatively, the cast was removed and active elbow motion was encouraged. Follow-up radiographs taken at four weeks after the operation showed good anatomical reduction without any remarkable changes in the physeal line (Fig. 2-B). There was no pain with the elbow movement or tenderness over the fracture site. The patient could flex 130 degrees and extend -5 degrees at his right elbow while he could flex 140 degrees and extend 0 degree at left. Although the patient was told to visit the hospital at two weeks interval, he had not been seen until three months after the operation. Radiographs demonstrated fracture union with premature closure of the physis of right olecranon (Fig. 2-C), and the retained metal was removed. The right elbow motion was completely restored. At age fifteen when the growth plate of left proximal ulna was totally closed, no deformity of right olecranon was observed (Fig. 2-D). There was no significant discrepancy between bilateral ulnar length.

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Present address: Department of Orthopaedic Surgery, Moriyama City Hospital, 4-14-1 Moriyama, Moriyama City Shiga 524, Japan

索引用語: 骨端線損傷, 肘頭部骨端線, 手術, 合併症, 骨端線早期閉鎖

Key words: physeal injury, olecranon physis, operation, complication, premature physeal closure

### Discussion

Separation of the olecranon epiphysis is possibly caused by direct blow onto the elbow or by avulsion forces on the proximal part of the ulna<sup>1,3-5</sup>). The fracture usually takes place through the metaphyseal bone adjacent to the physal line<sup>4,6,7</sup>). Fractures involving the olecranon physis are classified into two types<sup>4</sup>). In the first type which may occur in the younger children, the fracture is only through the growth plate, compatible with a Salter-Harris type-I physal injury. In the second type, there is a metaphyseal fragment attached to the epiphysis like the current case (Fig. 1-A). The second fracture pattern is considered to be compatible with a Salter-Harris type II injury, and is usually seen in the older children. It has been suggested that the insertion of triceps expansion in the metaphysis distal to the ulnar proximal physis makes the olecranon physal separation difficult to occur<sup>4</sup>).

As in the current case, surgeons should be aware that premature closure of the olecranon physis is a potential complication of operative treatment for a displaced physal fracture of the olecranon. While ossification of the olecranon develops in the area of the triceps insertion at age nine, fusion of the epiphysis with the metaphysis takes place about the age of fourteen<sup>8</sup>). Since the displaced physal fracture of the olecranon occurred in a twelve-year-old boy near skeletal maturity and growth plate of the proximal ulna contributes approximately 20% to the whole longitudinal growth of the ulna<sup>6,7</sup>), premature closure of the olecranon physis after surgery in the present case are considered to



**Fig. 1A** Lateral radiograph showing a displaced fracture of the physis of right olecranon.



**Fig. 1B** Lateral radiograph of left intact olecranon taken for comparison.



Fig. 2A



Fig. 2C



Fig. 2B



Fig. 2D

**Fig. 2A to D** A series of lateral radiographs of the right elbow taken at operation (A), four weeks (B) and three months (C) after operation, and at physal closure of the contralateral olecranon (D). Although no remarkable alteration in the physal line is demonstrated at four weeks after operation (B), premature closure of the physis is evident three months postoperatively (C). The latest radiograph (D) shows no significant deformity in the olecranon at skeletal maturity.

result in no significant growth disturbance at the latest follow-up examination (Fig. 2-D). However, it is important to select appropriate treatment to prevent premature closure which may lead to significant growth arrest especially in younger children.

In review of the literature, no standard method of treatment seems to be established for the olecranon physeal fractures<sup>1,2,4</sup>). Closed treatment may not be successful because the pull of triceps causes further displacement of an obtained anatomical restoration by immobilization<sup>9</sup>). Therefore, most authors have recommended surgical treatment for displaced fractures<sup>1,4,6,7,10</sup>). They have found that open reduction and internal fixation using a combination of Kirschner wires and a figure-of-eight tension-band loop provided good stability of the reduction. In addition, they have reported that anatomical results after operation was satisfactory. However, effects of secure fixation with tension band technique on the fractured physis of the olecranon or timing of retained metal removal has not been mentioned in detail. Premature physeal closure in the current case may be caused by delay of the retained metal removal or by excessive fixative force with tension band wiring. In general, the advise to prevent distortion of the physis is to remove retained metal as soon as the physis is healed and to avoid excessive compression<sup>4</sup>). In a reported case of an eleven-year-old child with bilateral displaced physeal fractures of the olecranon, open reduction and internal fixation has been performed using tension band wiring and the hardware was removed at three months after the surgery. At one-year follow-up, anatomical result has been reported to be excellent without description about alterations in the growth plate of the proximal ulna<sup>1</sup>). From our experience that four-weeks' fixation appeared to achieve adequate fracture healing to maintain anatomical reduction (Fig. 2-B), the hardware could be removed four weeks after operation to avoid premature closure of the olecranon physis with tension band wiring. In spite of early removal of the hardware, it is possible that compressive forces produced by tension band wiring themselves distort the olecranon physis. One resolution to avoid excessive compression is the use of absorbable suture as a tension band loop because absorbable suture reduces its tension with time and is completely absorbed eventually. As the alternative method, an olecranon physeal fracture in younger children could be fixed with absorbable suture alone with immobilization in a cast with the elbow flexed from 30 to 90 degrees<sup>9</sup>). Appropriate operation for a displaced physeal fracture of the olecranon in children will require secure fixation forces without disturbing the growth potential of the fractured physis to replace tension band wiring.

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和文抄録

## 肘頭部骨端線離開の1例

守山市民病院 整形外科

安田 義

尺骨肘頭部骨端線離開に対する手術後に骨端線閉鎖をきたした1例を経験したので報告する。

【症例】12歳，男児。転倒時に右肘関節部を打撲し転位を伴う肘頭部骨端線離開を受傷したため，tension band wiring 法で手術した。術後3ヵ月で早期骨端線閉鎖を認め，抜釘した。骨成長終了時尺骨の成長障害，変形は認めず，可動域制限も無かった。

肘頭部骨端線離開は稀な損傷で治療法は未だ確立され

ていない。観血的治療には tension band wiring が用いられているが，tension band wiring 自体が骨端線を損傷させる危険性がある。本症例の早期骨端線閉鎖は骨端線損傷の合併症の可能性もあるが<sup>2</sup>，手術法が骨端線閉鎖に関与した可能性もある。肘頭部骨端線は尺骨の成長に約20%しか関与しないとはいえ，抜釘時期に加えて若年者の場合手術法に注意する必要があると思われる。